REMARKS

Claims 1,3, and 5-9 remain in the case. Claims 1, 6, and 7 have been amended.

Claim 1 and claim 6 recite a method and apparatus, respectively, for operating an automotive engine including fuel injectors that open to deliver fuel to the engine. A mechanical returnless fuel system is provided for supplying fuel to the fuel injectors and also includes a fuel pump having a pump output. The pump output is substantially constant. The controller regulates an opening time for the fuel injectors to deliver the precise quantity of fuel. A spring-type pressure regulating valve is provided within a fuel tank and returns a portion of the pump output to the fuel supply instead of to the fuel injectors. The pressure regulating valve produces a fuel pressure that varies as a function of the engine fuel demand.

Minagawa is an electronic returnless fuel pump system which includes a pulse-width modulated fuel pump. Minagawa changes the current provided to the fuel pump to increase/decrease the fuel pump output for controlling the fuel pressure provided to the fuel injectors without any need for a regulating valve. Fuel pressure is estimated based on the fuel flow supply rate which is controlled by the electric varying supply current, and as a result, Minagawa delivers the exact amount of fuel required by the injectors. Minagawa is an entirely different basic structure than the present invention. To modify Minagawa to suggest a mechanical returnless fuel system that provides the substantially constant pump output as recited in the present invention is neither practical nor obvious to do.

Powell uses is a conventional diaphragm-type pressure regulator that opens to relieve pressure. Such diaphragm-type regulators are very effective for maintaining a constant fuel pressure. However, such diaphragm-type regulators add significant cost to the fuel system. When a diaphragm-type

regulator is used, then a constant pressure is maintained in the fuel lines as illustrated by the ideal constant pressure curve 72 shown in Fig. 2 of the present invention.

The pressure regulator of the present invention does not utilize a diaphragm-type pressure regulator but rather an unconventional regulator, and as a result, it outputs a linear but non-constant pressure output as illustrated by the pressure curve 70 shown in Fig 2. Powell's references three patents (US 5193576, US5163472, US 5193576) as examples of the conventional by-pass pressure regulators that are used in its system (see col. 2, lines 25-30). As stated earlier, the pressure regulator (23) of Powell provides a constant pressure whereas the pressure regulator of the present invention outputs a linearly varying, non-constant pressure. The linearly varying pressure has the advantage of varying the pressure in proportion to the engine fuel flow rate. As a result, the estimated fuel pressure based on the projected engine fuel demand provides a more accurate basis for determining the opening time for the fuel injectors and provides improved control of the automotive engine operation without requiring a fuel pressure sensor.

Minagawa and Powell, in combination, fail to teach or suggest each of the limitations of the present invention. Minagawa is an electronic returnless fuel system that varies the pumps output, and such systems, are not energy efficient. Minagawa fails to teach or suggest the mechanical returnless fuel system. In addition, Powell fails to describe a spring-type pressure regulator having a linear but non-constant output that is disposed within the fuel tank. The present invention simplifies the fuel delivery system by utilizing simple and less expensive components that operate in a cooperative and nonobvious manner. Providing such a simplified system provides a novel and useful invention by reducing cost, complexity, and is energy efficient. The fuel delivery system of the present invention as a whole is neither shown by the prior art nor suggested by the prior art. The Office action has individually referenced complex components and systems while suggesting that such complex components could be substituted to perform the functions of the

present invention. Such a substitution would be neither practical nor obvious to do. Therefore, claims 1, 3, and 5-9 are allowable.

In view of the foregoing amendment and remarks, all pending claims are in condition for allowance. Favorable action is respectfully solicited.

Respectfully submitted,

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